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(54) Title of the Invention: Output Method in Three-dimensional CAD

(57) [Abstract]

[Objectives] The present invention relates to batch output of a file of a specification, a drawing and the like, or to screen display of the file, in a three-dimensional CAD system having a hierarchical structure of parts. When one part is designated, a file of a specification, a drawing and the like of a part, which belongs to a lower or higher hierarchy than that of the designated part in the hierarchical structure, is outputted in a batch or is displayed on a screen. Accordingly, a user can carry out the output with simple operations even in a case of an assembly having a large number of parts.

[Configuration] The present invention is configured of a part designation processing unit which lists parts belonging to a lower or higher hierarchy than that of a designated part,

and which highlights a portion of the parts in each of a table, and which represents the hierarchical structure of the parts, and a three-dimensional shape of the designated part, and is configured of an output processing unit for respectively carrying out batch output or screen display of a file including a specification, a drawing or the like with respect to the all of the parts listed by the part designation processing unit.

[Scope of Claims]

[Claim 1] An output method in three-dimensional CAD, wherein a file of a specification, a drawing and the like with respect to a child part, which belongings to a hierarchy lower than that of a designated part, is outputted in a batch, or is displayed on a screen, in a three-dimensional CAD system having a hierarchical structure of parts.

[Claim 2] An output method in three-dimensional CAD, wherein a file of a specification, a drawing and the like with respect to a child part, which belongings to a hierarchy higher than that of a designated part, is outputted in a batch, or is displayed on a screen, in a three-dimensional CAD system having a hierarchical structure of parts.

[Claim 3] An output method in three-dimensional CAD, wherein a child part of a part is simplistically displayed as an initial display of the part having a child, such as any one of an assembly and a partial assembly, in the CAD system according to any one of claims 1 and 2.

[Claim 4] An output method in three-dimensional CAD, wherein a simplistically displayed portion is switched to a detailed display performed in a way that an assembly, a partial assembly, and parts are displayed in this order by designation by a user in the CAD system according to claim 3.

[Claim 5] An output method in three-dimensional CAD, wherein any one of outputting a file and highlighting of a three-dimensional shape of an object portion and a hierarchical structure of parts is performed

in the CAD system according to any one of claims 1 and 2.

[Claim 6] An output method in three-dimensional CAD, wherein a name of a child part and attribute information thereof are outputted as a parts list at a time of outputting a drawing of a part having the child part in the CAD system according to any one of claims 1 and 2.

[Claim 7] An output method in three-dimensional CAD, wherein a balloon is automatically created at a time of outputting a drawing of a part having a child part in the CAD system according to any one of claims 1 and 2.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] The present invention relates to an output method in three-dimensional CAD for carrying out batch output or screen display of a file of a specification, a drawing and the like, which is suitable for a three-dimensional CAD system for dealing with a large scale assembly.

[0002]

[Prior Art] Conventionally, in a case where a projection drawing is outputted in a three-dimensional CAD system, as disclosed in, for example, Japanese Patent Laid-open Application No. Sho 62-226376, entitled "Method for Two-dimensional Display of Three-dimensional Solid", all shapes that are displayed on a three-dimensional screen are projected on a two-dimensional screen. For the projection, at a time of outputting the projection drawing from a three-dimensional assembly, the projection drawing is outputted after only a shape of an object part of the assembly is displayed and others are set to be not displayed.

[0003]

[Problems to be Solved by the Invention] In such a method, there is required an extra work that only the shape of an output object is displayed and the others

are set to be not displayed. It is an object of the present invention to solve the above-described problem and to provide an output method in a three-dimensional CAD, which is suitable for batch output, or screen display, of a file of a specification of assembly, a drawing and the like.

[0004]

[Means for Solving the Problem] To solve the above-described problem, in the present invention, in a three-dimensional CAD system having a hierarchical structure of parts, when a user designates a part, to which outputting of a file of a specification, a drawing and the like in a batch, or displaying of the file on a screen, is required, on a table which represents the hierarchical structure of the parts, the three-dimensional shape of this portion and the table which represents the hierarchical structure of parts are highlighted, and the file of a specification, a drawing and the like is outputted in a batch or is displayed on a screen. The file is simplistically displayed as an initial display of a part, which has a child, such as an assembly and a partial assembly. However, this simple display can be changed anytime by designation by the user to a detailed display performed in a way that an assembly, a partial assembly, and parts are displayed in this order. Further, at the time of outputting the drawing, the name of a child part and attribute information thereof are outputted as a parts list and a balloon is added to the shape of the child part.

[0005]

[Operation] As described above, the part that the bath output or the screen display of the file such as a specification and a drawing is wanted, can be designated on the table that represents the hierarchical structure of the parts, and an output operation becomes easy even in a case of assembly having a large number of parts.

[0006]

[Example] Description of one example of the present invention will be given below based on the drawings. An example of outputting a projection drawing will be described herein. FIG. 1 shows a configuration diagram of the example of the present invention.

[0007] In FIG. 1, an input unit 1 is for designating an arbitral part from a table which represents a hierarchical structure of parts displayed on a display 2, or the like, by a mouse, a keyboard or the like. A processing unit 3 is configured of a part designation processing unit 4 and an output processing unit 5. The part designation processing unit 4 takes out the designated part from a bill of material displayed on the display 2 to be highlighted with respect to a three-dimensional shape thereof displayed on the display 2. The output processing unit 5 creates a two-dimensional projection drawing from a default or designated direction from three-dimensional shape data 8. When the object part to be projected has a child part, the name of the child part and attribute information thereof are outputted on the parts list in the drawing to add a balloon.

[0008] A data unit 6 is a memory which is a main memory device or a disk device which is an external memory device, the data unit storing parts configuration data 7, the three-dimensional shape data 8, part attribute data 9, output data 10, or the like. The parts configuration data 7 are for representing a hierarchical structure of an assembly, and are configured of a parent-child relation of a part number in this case. The three-dimensional shape data 8 are for representing a three-dimensional shape, and are configured of edge-A, edge-B, size-A, size-B, or like in this case. The part attribute data 9 are attribute data with regard to each part, and are configured of quality of material, weight, or the like in this case. The output data 10 are for representing a projection drawing.

[0009] FIG. 2 shows an explanatory diagram of the operation of the present invention. This shows a bill of material 21, a three-dimensional shape 22, projection drawings 23 and a parts list 24, all of which are displayed on the display 2. In FIG. 2, the bill of material 21 is for a tree view of the hierarchical structure of the parts. A vise 211, which is an assembly, has three parts as child parts which are a main body 212, which is a single part, a pressing unit 213, which is a partial assembly, and a screw unit 216, which is a partial assembly. Further, the pressing unit 213 which is a partial assembly has two parts as child parts. The parts are a clamp 214, which is a single part, and a presser plate 215, which is a single part. Similarly, the screw unit 216, which is a partial assembly, has three parts as child parts. The parts are a clamping screw 217, which is a single part, a handle 218, which is a single part, and a boss 219, which is a single part.

[0010] The part designated on the bill of material 21 is taken out by the part designation processing unit 4 in FIG. 1 in order to highlight the part in relation to the bill of material 21 and the three-dimensional shape 22. The projection drawing 23 is of line data and size data of the projection drawing, which are created by the output processing unit 5 in FIG. 1. The projection drawing is of the designated part when the three-dimensional shape of the part, which is designated on the bill of material 21, is seen from a certain direction (default direction or a direction designated by the user). The parts list 24 is of the names of parts, which belong to a hierarchy than that of the object part to be projected, and of the attribute information of the parts. The names and the attribute information are created by the output processing unit 5 in FIG. 1. Balloon 27 are balloons with respect to the shapes of the child parts of the designated part, which balloons are created by the output processing unit 5 in FIG. 1.

[0011] As an example of operations in such a configuration, five projection drawing output designation methods will be described below.

[0012] First, a description will be provided for a method of selecting a part, which is designated on the bill of material, and a child part directly belonging thereto, of outputting projection drawings thereof. For example, when the user moves a cursor to the vise 211 on the bill of material 21 through a mouse, and presses a button thereof, a computer selects the vise 211, the main body 212, the pressing unit 213, the screw unit 216, which are on the bill of material 21. Thereafter, the computer highlights parts, which corresponds to the selected parts, on the bill of material 21 and the three-dimensional shape 22 in different colors. Subsequently, the computer outputs a vise assembly drawing (the projection drawing of the main body 221, the clamp 222, the presser plate 223, the clamping screw 224, the handle 225, and the boss 226), a main body part drawing (the projection drawing of the main body 221), a pressing unit partial assembly drawing (the projection drawing of the clamp 222 and the presser plate 223), a screw unit partial assembly drawing (the projection drawing of the clamping screw 224, the handle 225, and the boss 226).

[0013] Next, a description will be provided for a method of selecting a part designated on the bill of material 21 and a direct parent part thereof, and of outputting projection drawings thereof. For example, when a backspace key is pressed after the cursor of the mouse is moved to the clamp 214 on the bill of material 21 through the mouse to press the button, the computer selects the clamp 214 and the pressing unit 213 which are on the bill of material 21. Thereafter, the computer highlights the parts, which corresponds to the selected parts, on the bill of material 21 and the three-dimensional shape 22 in different colors. Subsequently, the computer outputs a clamp part drawing (the projection drawing of the clamp 222), and a pressing unit partial assembly

drawing (the projection drawing of the clamp 222 and the presser plate 223).

[0014] Next, a description will be provided for a method of, on the bill of material 21, selecting a part designated on the bill of material 21 and all of parts belonging to a hierarchy lower than that of the selected part, and of outputting projection drawings thereof. For example, when the cursor is moved to the vise 211 on the bill of material 21 through the mouse to consecutively press the button of the mouse twice, the computer selects the vise 211, the main body 212, the pressing unit 213, the screw unit 216, further selects the clamp 214 and the presser plate 215, which are the child parts of the pressing unit 213, and selects the clamping screw 217, the handle 218 and the boss 219, which are the child parts of the screw unit 216. Thereafter, the computer highlights the parts, which corresponds to the selected parts, on the bill of material 21 and the three-dimensional shape 22 in different colors. Subsequently, the computer outputs a vise assembly drawing (the projection drawing of the main body 221, the clamp 222, the presser plate 223, the clamping screw 224, the handle 225, and the boss 226), a main part drawing (the projection drawing of the main body 221), a pressing unit partial assembly drawing (the projection drawing of the clamp 222 and the presser plate 223), a screw unit partial assembly drawing (the projection drawing of the clamping screw 224, the handle 225, and the boss 226), a clamping screw part drawing (the projection drawing of the clamping screw 224), a handle part drawing (the projection drawing of the handle 225), and a boss part drawing (the projection drawing of the boss 226).

[0015] Next, a description will be provided for a method of selecting a part designated on the bill of material 21 and all of parent parts thereof, and of outputting projection drawings thereof. For example, when the backspace key is pressed after the cursor is moved to the clamp 214 through the mouse on the

bill of material 21 to consecutively press the button of the mouse twice, the computer selects the clamp 214, the pressing unit 213, and the vise 211, all of which are on the bill of material 21. Thereafter, the computer highlights the selected parts on the bill of material 21 and the three-dimensional shape 22 in different colors. Subsequently, the computer outputs a clamp part drawing (the projection drawing of the clamp 222), a pressing unit partial assembly drawing (the projection drawing of the clamp 222 and the presser plate 223), and a vise assembly drawing (the projection drawing of the main body 221, the clamp 222, the presser plate 223, the clamping screw 224, the handle 225, and the boss 226).

[0016] Next, a description will be provided for a method of designating a region on the bill of material 21, and of outputting projection drawings of all of parts included in the region. For example, the cursor is moved to a position of PL 25 on the bill of the material 21 in FIG. 2 through the mouse, and then is moved to a position of PR 26 with the button of the mouse being pressed, and thereafter, the button of the mouse is released. Accordingly, on the bill of material 21, the computer selects the pressing unit 213 and the screw unit 216, selects the clamp 214 and the presser plate 215, which are the child parts of the pressing unit 213, and selects the clamping screw 217, the handle 218 and the boss 219, which are the child parts of the screw part 216. Thereafter the computer highlights parts, which correspond to the selected parts, on the bill of material 21 and the three-dimensional shape 22 in different colors. Subsequently, the computer outputs the pressing unit partial assembly drawing (the projection drawing of the clamp 222 and the presser plate 223), the clamp part drawing (the projection drawing of the clamp 222), a presser plate part drawing (the projection drawing of the presser plate 223), the screw unit partial assembly drawing (the projection drawing of the clamping screw 224, the handle 225, and

the boss 226), the clamping screw part drawing (the projection drawing of the clamping screw 224), the handle part drawing (the projection drawing of the handle 225), and the boss part drawing (the projection drawing of the boss 226).

[0017] Next, a description will be provided for a method of switching from a simple display to a detailed display with respect to the projection drawing of a part, which has a child, such as an assembly or a partial assembly. It should be noted that the detail display in this regard means that all shapes of parts and information required for manufacturing the part (processing size, finishing mark, or the like) are displayed, and the simple display means that the outer shape of the part and information required for assembly of the part (assembly size, balloon, or the like) are displayed.

[0018] As shown in FIG. 15, an assembly ASY1 is configured of partial assembly ASY2 and a single part P1 as child parts. As an initial projection drawing of the assembly ASY1, an assembly drawing is simplistically displayed as shown in FIG. 16(a). In this respect, when the ASY2 is double-clicked on the bill of material 21, or is double-clicked through a balloon, a partial assembly drawing of the ASY 2 is simplistically displayed as shown in FIG. 16(b). Further, when a P3 is double-clicked on the bill of material 21, or is double-clicked through a balloon, the part drawing of the P3 is displayed in detail as shown in FIG. 16(c).

[0019] Next, according to an order shown in the flowchart of FIG. 3, a detailed description of the part designation processing unit 4 having the configuration of FIG. 1 will be given below. In FIG. 3, in Step S1, parts are listed by utilizing the parts configuration data 7 according to an output designation system of the above-described projection drawing. In Step S2, data for display are recreated. In the data, with respect to the parts listed in Step S1, the colors of the portions corresponding to the listed parts are changed in the bill of material 21

and the three-dimensional shape 22. In Step S3, the data for display recreated in Step S2 are redisplayed on the bill of material 21 and the three-dimensional shape 22 on the display 2. Because of this, the user can confirm which of parts drawings to be outputted are of, at the time of designation. For example, when the user moves the cursor of the mouse to the pressing unit 213 on the bill of material 21 to press the button, the computer highlights respective characters of the pressing unit 213, the clamp 214, and the presser plate 215, which are on the bill of material 21, and respective three-dimensional shapes of the clamp 222 and the presser plate 223 on the three-dimensional shape 22 in FIG. 2 are highlighted in different colors. It should be noted that the highlighted display is returned to the original display at the timing when a certain operation is carried out by the user.

[0020] Next, the output processing unit 5 having the configuration of FIG. 1 will be described in detail. The projection drawings are concurrently outputted by repeatedly carrying out the processing shown in FIGS. 4 and 5 with respect to all of the parts listed in Step S1 in FIG. 3. For example, when the cursor is moved to the pressing unit 213 on the bill of material 21 in FIG. 2 through the mouse to press the button thereof, the processing shown in FIGS. 4 and 5 are repeatedly carried out in relation to the pressing unit, the clamp, and the presser plate. Accordingly, a parts assembly drawing of the pressing unit 213, a part drawing of the clamp 214, and a part drawing of the presser plate 215 are outputted in a batch. A system in which the projection drawing is outputted while having a dialogue with the user is shown in the flowcharts in FIGS. 4 and 5, and a system in which the projection drawings are outputted in a batch is shown in the flowchart in FIG. 6.

[0021] First, the system in which the projection drawing is outputted while the computer has a dialogue with the user will be described. In FIG. 4, in Step

S11, a name of the part on the bill of material 21 on the display 2 in FIG. 2 with respect to the object part to be processed is highlighted in a different color. Concurrently, all of parts including the object parts and parts, which are lower than the object part with regard to the hierarchical structure, are highlighted in the different color in the three-dimensional shape 22 on the display 2 in FIG. 2. Because of this, the user can understand which of the parts an object drawing to be output is of.

[0022] In Step S12, the user is required to designate, through the input unit 1 in FIG. 1, face views to be outputted and a line-of-sight direction of a front view thereof. As a method of designating the face view, the designation is made through the table shown in FIG. 7. As a method of designating the front view direction, the designation is made through a marker shown in FIG. 8. Next, Steps S13 to S15 are repeated only for the face views designated in Step S12. In Step S13, the matrix operation is carried out in relation to a line-of-sight direction vector of each of the front views designated in Step S12 to obtain the line-of-sight direction of the face view. In Step S14, as shown in FIG. 9, a projection shape of the object part to be processed is obtained. It should be noted that a method of obtaining the projection shape will be described later in detail according to the flowchart of FIG. 14. In Step S15, as shown in FIG. 10, a rectangle CUBE1, which is, for example, 10% larger than a minimum rectangle containing the projection shape obtained in Step S14, is obtained.

[0023] In FIG. 5, in Step S21, according to the layout of each face view shown in FIG. 7, rectangles CUBE1 of the face views obtained in Step S15 are laid out as shown in FIG. 11. Concurrently, a rectangle CUBE2, which is, for example, 10% larger than a minimum rectangle containing the rectangles CUBE1, is obtained. In Step S22, the ratio of length between length and width of the rectangle CUBE2 obtained in Step S21, is obtained. In Step S23, the value

obtained in Step S22 is compared with the ratio of length between length and width of the actual drawing sizes of A0, A1, A3, ...to determine one having the closest value as the size of the projection drawing.

[0024] In Step S24, the names of all of the parts including the object part to be processed and the parts, which are lower than the object part with respect to the hierarchical structure, and the part attribution data thereof are outputted as the parts list on the projection drawing determined in Step S23. In Step S25, obtained is the maximum magnification with which, as shown in FIG. 12, the rectangle CUBE2 obtained in Step S22 is within the projection drawing and the rectangle CUBE2 does not overlap with the parts list outputted in Step S24. In Step S26, the value of the rectangle CUBE2 obtained in Step S21 is multiplied by the valued obtained in Step S25. In Step S27, display data are created from the result of Step S26, and a balloon is displayed on the rectangle CUBE1 of the front view as shown in FIG. 13, whereby the display data are displayed as the projection drawing 23 on the display 2 in FIG. 2. In Step S28, the result of Step S26 is stored as output data 10 of the data unit 6 in FIG. 1.

[0025] Next, the system in which projecting drawings are outputted in a batch will be described. The system using a dialogue as described in FIGS. 4 and 5 is carried out by inquiring of the user about a type of a face view to be created and a line-of-sight direction of the front view for every projection drawings. However, the system using a batch, which will be described below, uses a type of a face view to be created on the projection drawing and a line-of-sight direction of the front view, which are given in advance, whereby no request is made for the user.

[0026] In FIG. 6, Steps S31 to S33 are repeated only for the face views given in advance. In Step S31, the line-of-sight direction of each face view is calculated. In Step S32, as shown in FIG. 9, the projection shape of the object part to be

processed is obtained. It should be noted that a method of obtaining the projection shape will be described later in detail according to the flowchart of FIG. 13. In Step S33, as shown in FIG. 10, a rectangle CUBE1, which is, for example, 10% larger than a minimum rectangle containing the projection shape obtained in Step S32, is obtained. In Step S35, according to such layout of each face view as shown in FIG. 7, rectangles CUBE1 of the face views obtained in Step S33 are laid out as shown in FIG. 11. Concurrently, a rectangle CUBE2, which is, for example, 10% larger than a minimum rectangle containing the rectangles CUBE1, is obtained.

[0027] In Step S36, the ratio of length between length and width of the rectangle obtained in Step S35, is obtained. In Step S37, the value obtained in Step S35 is compared with the ratio of length between length and width of the actual drawing sizes of A0, A1, A3, ...to determine one having the closest value as the size of the projection drawing. .

[0028] In Step S38, the names of all of the parts including the object part to be processed and the parts, which are lower than the object part with respect to the hierarchical structure, and the part attribution data thereof are outputted as the parts list on the projection drawing determined in Step S37. In Step S39, obtained is the maximum magnification with which, as shown in FIG. 12, the rectangle CUBE2 obtained in Step S35 is within the projection drawing and the rectangle CUBE2 does not overlap with the parts list outputted in Step S38. In Step S40, the value of the rectangle CUBE2 obtained in Step S35 is multiplied by the valued obtained in Step S39. In Step S41, the result of Step S40 to which result balloons are added is stored as output data 10 of the data unit 6 in FIG. 1.

[0029] Lastly, a method of obtaining a projection shape will be described according to the flowchart of FIG. 14.

[0030]In Step S51, the child parts of the object part to be processed are listed. In Step S53, it is examined whether or not the parts listed in Step S51 have other child parts. In Step S54, in the case of the part, to which the determination that the child parts are not included is made in Step S53, backup projection data are created. In the backup projection data, a portion, where the part shape is blocked and is not seen when viewed from the line-of-sight direction of the face view, is displayed by the dotted line. In Step S55, in the case of the part, to which the determination that the child parts are included is made in Step S53, backup projection data are created. In the backup projection data, a portion, where all of the shapes of parts belonging to a hierarchy lower than that of the listed parts are blocked and are not seen viewed from the line-of-sight direction of the face view, is not displayed. In Step S56, all of the backup data obtained in Steps S54 and S55 are superimposed to create the projection data.

[0031]

[Effects of the Invention] As described above, according to the present invention, a user can designate a part on the bill of material, to which part batch output of a file such as a specification and a drawing, or screen display thereof, is required. Accordingly, the part in each of a three-dimensional shape and the bill of material on the display is highlighted when designated, and then the file such as a specification and a drawing with respect to child parts or parent parts of the designated part is outputted in a batch or is displayed on a screen. In the case of the part, which has child parts, this portion is simplistically displayed as an initial display. However, it can be changed to a detailed display performed in a way that an assembly, a partial assembly, and parts are displayed in this order by designation by a user. In addition, at the time of outputting a drawing of a part having child parts, the names of the child

parts and the attribute information thereof are outputted as the parts list and balloons are automatically added. Therefore, there can be obtained an effect that output operations can be easily carried out within a short time even in the case of an assembly having a large number of parts.

[Brief Description of the Drawings]

[FIG. 1] FIG. 1 is a configuration diagram of one example of the present invention.

[FIG. 2] FIG. 2 is a diagram for describing operations of the present invention.

[FIG. 3] FIG. 3 is a flowchart of a part designation processing unit of the present invention.

[FIG. 4] FIG. 4 is a flowchart (dialogue 1) of a projection drawing output processing unit of the present invention.

[FIG. 5] FIG. 5 is a flowchart (dialogue 2) of the projection drawing output processing unit of the present invention.

[FIG. 6] FIG. 6 is a flowchart (batch) of the projection drawing output processing unit of the present invention.

[FIG. 7] FIG. 7 is a diagram for showing a screen selection of the projection drawing output processing unit.

[FIG. 8] FIG. 8 is a diagram for showing a front view direction selection of the projection drawing output processing unit.

[FIG. 9] FIG. 9 is a diagram for showing projection of the projection drawing output processing unit.

[FIG. 10] FIG. 10 is a diagram for describing a screen size of the projection drawing output processing unit.

[FIG. 11] FIG. 11 is a diagram for describing determination on layout and a size of each screen of the projection drawing output processing unit.

[FIG. 12] FIG. 12 is a diagram for describing determination on a magnification

of the projection drawing output processing unit.

[FIG. 13] FIG. 13 is a diagram for describing display of a balloon of the projection drawing output processing unit.

[FIG. 14] FIG. 14 is a flowchart of a projection shape creation processing unit.

[FIG. 15] FIG. 15 is a diagram for showing a projection shape display.

[FIG. 16] FIGS. 16 are diagrams for describing the projection shape display.

[Reference Numeral]

1 Input unit

2 Display

21 Bill of material

211-219 Components of bill of material

22 Three-dimensional shape

221-226 Three-dimensional shape of part

23 Projection drawing

24 Parts list

25, 26 Field designating point

27 Balloon

3 Processing unit

4 Part designation processing unit

5 Output processing unit

6 Data unit

7 Parts configuration data

8 Three-dimensional shape data

9 Part attribute data

10 Output data